

METHOD FOR VERIFYING A CONTRACTOR'S LABORATORY MIX DESIGN

1. SCOPE:

- 1.1. This method is intended for use by Kentucky Transportation Cabinet (Cabinet) personnel, both District and Division of Materials (Division), in verifying a contractor's laboratory mix design, hereinafter referred to as the "contractor's design." This laboratory mix design may have been produced by the contractor's own personnel or by a commercial laboratory. The verification process involves comparing values from the contractor's design to results from the Cabinet, either the District or the Division, hereinafter referred to as the "evaluating authority."
 - 1.1.1. In the case of District personnel, the comparison involves the testing of ESAL Class 1 and 2 mixtures. The District will compare the values from the contractor's design to the District's results from the gyratory specimens and maximum-specific-gravity (G_{mm}) samples produced by the contractor.
 - 1.1.2. In the case of Division personnel, the comparison involves the testing of ESAL Class 3 and 4 mixtures, Sand Asphalt (Type I or II), Sand Seal Surface, or any specialty mixtures (such as mixtures containing solid additives, stone-matrix asphalt, etc.). The Division will compare the values from the contractor's design to the Division results from the gyratory specimens and G_{mm} samples produced by the contractor and/or to the results from the Division design [normally a one-point check at the contractor's declared optimum asphalt content (AC)].
- 1.2. If the comparison between the contractor's design and the applicable Cabinet testing satisfies the given tolerances, then the Cabinet will consider the contractor's design acceptable for use. If the same comparison fails to satisfy the given tolerances, further investigation will be necessary. To this end, this method offers possible investigative steps to pursue.

2. REFERENCED AND RELATED STANDARDS: The equipment required to complete the verification described in this method is found in a number of other methods. Also, this method references several other methods and standards. These standards include the following:

2.1. Kentucky Methods:

KM 64-411, *Preparing Ingredient Materials for, and Performing, a Laboratory Mix Design of an Asphalt Mixture*

KM 64-421, *Establishing the Job-Mix Formula of Asphalt Mixtures by the Contractor*

KM 64-435, *Method for Acceptance of Asphalt Mixtures by Mixture Property Analysis*

2.2. AASHTO Standards:

M 323, *Superpave Volumetric Mix Design*

R 35, *Superpave Volumetric Design for Hot-Mix Asphalt (HMA)*

T 84, *Specific Gravity and Absorption of Fine Aggregate*

T 85, *Specific Gravity and Absorption of Coarse Aggregate*

T 176, *Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test*

T 304, *Uncompacted Void Content of Fine Aggregate*

2.3. ASTM Standards:

D 4791, *Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate*

D 4867, *Effect of Moisture on Asphalt Concrete Paving Mixtures*

D 5821, *Determining the Percentage of Fractured Particles in Coarse Aggregate*

3. PROCEDURE:

3.1. Verifying the Contractor's Design for ESAL Class 1 or 2 Mixtures:

3.1.1. As required by KM 64-421, the contractor must submit two gyratory specimens and two G_{mm} samples, along with the laboratory design performed according to R 35, to the evaluating authority (normally the District). The evaluating authority tests these specimens and G_{mm} samples and compares the results to those corresponding values from the contractor's design.

3.1.2. The evaluating authority will compare the bulk specific gravity (G_{mb}) value at the contractor's declared optimum AC to the average G_{mb} result from the evaluating authority's tests. Likewise, the evaluating authority will compare the G_{mm} value at the contractor's declared optimum AC to the average G_{mm} result from the evaluating authority's tests.

3.1.3. The results from the specimens and G_{mm} samples tested by the evaluating authority must compare to those values from the contractor's design within the following tolerances in order to successfully "verify" the contractor's design. These tolerances are similar to those values given in KM 64-435.

G_{mb} : ± 0.024

G_{mm} : ± 0.015

Air Voids (%): ± 1.2

VMA (%): ± 1.5

- 3.1.4. If the evaluating authority successfully verifies the contractor's design, the evaluating authority will report the mixture as acceptable at the contractor's declared optimum AC using the mixture values from the contractor's design. The evaluating authority may adjust the recommended AC if extensive justification (such as experience with similar mixtures, extreme traffic or loading conditions, etc.) is available. If the evaluating authority does not successfully verify the contractor's design, the evaluating authority will follow the procedure outlined in the following subsection of this method.
- 3.1.5. If the evaluating authority does not successfully verify the contractor's design, the evaluating authority will perform further investigation to determine the cause of the discrepancy. Specifically, the evaluating authority will follow the guidelines given in Subsection 113.07 of the Cabinet *Standard Specifications for Road and Bridge Construction* (Specifications) in an attempt to determine the cause of the discrepancy. The evaluating authority will decide which items to investigate. The difference in values will occur in the G_{mb} value, the G_{mm} value, or both.
- 3.2. Verifying the Contractor's Design for ESAL Class 3 or 4 Mixtures, Sand Asphalt (Type I or II), Sand Seal Surface, or Any Specialty Mixtures (Such as Mixtures Containing Solid Additives, Stone-Matrix Asphalt, etc.)
- 3.2.1. As required by KM 64-421, the contractor must submit a laboratory design; samples of aggregate, asphalt binder, and liquid anti-stripping additive (if used); and two gyratory specimens and two G_{mm} samples to the evaluating authority. The evaluating authority (normally the Division) may choose to verify the contractor's design in one of two ways. The evaluating authority may choose to only test the two gyratory specimens and two G_{mm} samples submitted by the contractor. In this case, the procedure described in Subsection 3.1 of this method applies. Otherwise, the evaluating authority may choose to test the two gyratory specimens and two G_{mm} samples submitted by the contractor and to perform a laboratory mix design (normally a one-point check at the contractor's declared optimum AC) on the mixture in question. In this case, the procedure described in the following subsections of this method applies.
- 3.2.2. Aggregate Properties:
- 3.2.2.1. Specific Gravity:

- 3.2.2.1.1. The evaluating authority will perform specific gravity testing on all component aggregates in the mixture, according to T 84 and T 85, and compare these results to the values reported in the contractor's design. If the specific gravity result of a given aggregate component compares to the value reported in the contractor's design within ± 0.03 , then the evaluating authority will use the value reported in the contractor's design in all successive calculations. If the specific gravity result of a given aggregate component does not compare to the value reported in the contractor's design within ± 0.03 , then the evaluating authority will follow the procedures outlined in the following subsection of this method.
- 3.2.2.1.2. The evaluating authority will perform specific gravity testing on another portion of the component aggregate in question. If the average of this retested result and the original result still does not compare to the value reported in the contractor's design within ± 0.03 , then the evaluating authority will perform a review of the historical specific gravity data for that particular source and size. If the average of the retested result and the original result compares adequately, in the opinion of the evaluating authority, to the historical data, then the evaluating authority will use the average of the retested result and the original result in all successive calculations. If not, the evaluating authority will conduct an in-depth investigation of the discrepancies on a case-by-case basis. This investigation may involve obtaining and testing another sample of the component aggregate in question to determine if the specific gravity of the source has changed. The evaluating authority may also require comparison testing with the contractor.

3.2.2.2. Consensus Properties:

- 3.2.2.2.1. The evaluating authority will perform aggregate testing to determine the Superpave consensus properties for the mixture: coarse-aggregate angularity according to D 5821; flat-and-elongated particles according to D 4791; fine-aggregate angularity according to T 304 (Method A); and sand equivalency according to T 176. These results must compare to those values from the contractor's design within the following tolerances in order to successfully "verify" the contractor's design.

Coarse-Aggregate Angularity (%):	± 10 for both one-or-more and two-or-more crushed faces
Flat-and-Elongated (%):	± 5
Fine-Aggregate Angularity (%):	± 2
Sand Equivalent (%):	± 15

- 3.2.2.2.2. If the evaluating authority's result of a given aggregate consensus property compares to the value reported in the contractor's design within the tolerance given in the preceding subsection of this method, then the evaluating authority will use the value reported in the contractor's design in the judgment of the mixture's acceptability. If a given aggregate consensus property does not compare to the value reported in the contractor's design within the tolerance given in the preceding subsection of this method, then the evaluating authority will follow the procedures outlined in the following subsection of this method.
- 3.2.2.2.3. The evaluating authority will perform aggregate testing on another portion of aggregate for the consensus property in question. If the average of this retested result and the original result compares to the value reported in the contractor's design within the tolerance given in Subsection 3.2.2.2.1 of this method, then the evaluating authority will use the value reported in the contractor's design in the judgment of the mixture's acceptability. If the average of this retested result and the original result still does not compare to the value reported in the contractor's design within the tolerance given in Subsection 3.2.2.2.1 of this method, then the evaluating authority will use the average of the retested result and the original result in the judgment of the mixture's acceptability.

3.2.3. Mixture Volumetrics:

- 3.2.3.1. The evaluating authority will compare the average G_{mb} value at the contractor's declared optimum AC point from the contractor's design to the corresponding G_{mb} result from the evaluating authority's design (one-point check). Likewise, the evaluating authority will compare the G_{mm} value at the contractor's declared optimum AC point from the contractor's design to the corresponding G_{mm} result from the evaluating authority's design (one-point check).
- 3.2.3.2. The results from the evaluating authority's design must compare to

those values from the contractor's design within the following tolerances in order to successfully "verify" the contractor's design. These tolerances are similar to those values given in KM 64-435.

G_{mb} : ± 0.024

G_{mm} : ± 0.015

Air Voids (%): ± 1.2

VMA (%): ± 1.5

- 3.2.3.3. If the evaluating authority successfully verifies the contractor's design, the evaluating authority will report the mixture as acceptable at the contractor's declared optimum AC, using the mixture values from the contractor's design. The evaluating authority may adjust the recommended AC if extensive justification (such as experience with similar mixtures, extreme traffic or loading conditions, etc.) is available. If the evaluating authority does not successfully verify the contractor's design, the evaluating authority will follow the procedure outlined in the following subsection of this method.
- 3.2.3.4. If the evaluating authority does not successfully verify the contractor's design, the evaluating authority will perform further investigation to determine the cause of the discrepancy. The following items are possibilities to investigate in an attempt to determine the cause of the discrepancy. The evaluating authority will decide which items to investigate. The difference in values will occur in the G_{mb} value, the G_{mm} value, or both.
- 3.2.3.4.1. The evaluating authority may elect to investigate some or all of the items offered in Subsection 113.07 of the Specifications.
- 3.2.3.4.2. In addition, the evaluating authority may elect to repeat some or all of the laboratory design (one-point check), including the "weigh-up," mixing, compacting, and testing of the mixture. Also, depending on the source of the discrepancy, the evaluating authority may investigate only the G_{mb} or the G_{mm} .
- 3.2.3.4.3. At the conclusion of the investigation, the evaluating authority will resolve the difference(s) between the values from the contractor's design and the results from the evaluating authority's design (one-point check) according to Subsection 113.07 of the Specifications.

3.2.4. Tensile Strength Retained (TSR):

- 3.2.4.1. The contractor must report a value for the TSR of the mixture, performed according to D 4867, as a part of the laboratory design submitted to the evaluating authority. The evaluating authority may also perform TSR testing on the mixture as part of the verification of the contractor's laboratory design and compare the result to the TSR value from the contractor's design.
- 3.2.4.2. The TSR result from the evaluating authority's design must compare to the value from the contractor's design within $\pm 20\%$ in order to successfully "verify" the contractor's design. If the TSR result from the evaluating authority's design compares to the value reported in the contractor's design within $\pm 20\%$, then the evaluating authority will use the value reported in the contractor's design in the judgment of the mixture's acceptability. If the TSR result from the evaluating authority does not compare to the value reported in the contractor's design within $\pm 20\%$, then the evaluating authority will follow the procedures outlined in the following subsection of this method.
- 3.2.4.3. If the evaluating authority does not successfully verify the contractor's design, the evaluating authority will perform further investigation to determine the cause of the discrepancy. The following items are possibilities to investigate in an attempt to determine the cause of the discrepancy. The evaluating authority will decide which items to investigate.
 - 3.2.4.3.1. The evaluating authority may elect to investigate some or all of the items offered in Subsection 113.07 of the Specifications.
 - 3.2.4.3.2. In addition, the evaluating authority may elect to repeat some or all of the TSR test, including the "weigh-up," mixing, compacting, and testing of the mixture. The evaluating authority may elect to repeat the TSR test on specimens without anti-stripping additive, with anti-stripping additive, or both.
 - 3.2.4.3.3. At the conclusion of the investigation, the evaluating authority will resolve the difference(s) between the values from the contractor's design and the results from the evaluating authority's design according to Subsection 113.07 of the Specifications.

4. MIXTURE VERIFICATION:

- 4.1. The purpose of this method is the verification of the contractor's design by the evaluating authority. This verification process involves several separate steps, including volumetrics, aggregate, and TSR testing. It is entirely possible that the evaluating authority may successfully verify some aspects of the mixture design and not successfully verify other aspects. In turn, it is also possible that in the report of the mixture's acceptability, some values may be from the contractor's design, and some results may be from the evaluating authority's tests.
- 4.2. It is not the responsibility of the evaluating authority to necessarily approve the mixture, but rather to verify the mixture's properties in order to establish its quality at the laboratory stage. If the evaluating authority verifies the mixture at the laboratory stage, it is then probable that the mixture will provide an adequate "starting point" for future plant production.
- 4.3. It is also not necessary that the results from the evaluating authority's tests satisfy the applicable mixture criteria; the purpose of this verification process is only to ensure that the evaluating authority's evaluation satisfies the aforementioned tolerances. Additionally, a case may arise in which the result from the evaluating authority's test does not fall within the specified tolerance of the result from the contractor's test, but the result from the evaluating authority's test does satisfy the applicable specification. In this case, the evaluating authority may deem that property to be acceptable despite the unsuccessful verification with the contractor's design.
- 4.4. After verifying each aspect of the contractor's design, or otherwise determining that its result is the more correct value to report, then the evaluating authority will report the mixture's acceptability on the most current version of the "Asphalt-Mixture-Design-Results Form." This form is an Excel spreadsheet distributed by the Division, commonly known as "MixPack." Depending on the success of the evaluating authority's verification, the values reported on the spreadsheet may be from the contractor's design, the evaluating authority's tests, or some combination of both.

- 4.5. If the evaluating authority does not verify some or all of the mixture properties, and the evaluating authority determines that its result(s) is the more correct value(s) to report, and this result(s) fails to satisfy the applicable criteria, then the evaluating authority will not report the mixture as acceptable at the laboratory stage. In this case, the contractor must make appropriate adjustments and submit another design to the evaluating authority for verification.

APPROVED _____
Director
Division of Materials

DATE 12/28/04

Kentucky Method 64-443-05
Revised 12/28/04
Supersedes KM 64-443-03
Dated 1/15/03

k4430105.doc